IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Alan D. Cetel
Serial No.:	10/023,565
Filed:	December 18, 2001
Group Art Unit:	1793
Examiner:	Sheehan, John P.
Title:	High Strength, Hot Corrosion and Oxidation Resistant, Directionally Solidified Nickel Base Superalloy and Articles

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Subsequent to the filing of a Notice of Appeal on March 26, 2010, Appellant now submits its brief. The Appeal Brief fee was previously paid on July 20, 2005. The Commissioner is hereby authorized to charge $130 to Deposit Account No. 50-1482 in the name of Carlson, Gaskey & Olds, P.C. If any additional fees are necessary, you are hereby authorized to charge Deposit Account No. 21-0279 in the name of United Technologies Corporation.

Real Party in Interest

The real party in interest is United Technologies Corporation, assignee of the present application.

Related Appeals and Interferences

A Notice of Appeal was filed on March 22, 2005; Appeal Brief on July 20, 2005; Order Returning Undocketed Appeal to Examiner dated November 29, 2006;

Supplemental Appeal Brief dated July 24, 2007; Examiner's Answer dated October 26, 2007; and Decision on Appeal dated July 21, 2008.

Status of Claims

Claim 4 was previously cancelled. Claims 15-19 were withdrawn from consideration. Claims 1-3 and 5-14 stand rejected and are appealed.

Status of Amendments

All amendments have been entered.

Summary of Claimed Subject Matter

The present application generally relates to nickel based superalloys and articles having high strength and corrosion resistance. The application includes two independent claims (claims 1 and 12), which are summarized as follows.

Independent claim 1 recites a directionally solidified article having more than one crystal and comprising a high strength, corrosion and oxidation resistant nickel base superalloy. The superalloy includes a matrix and from about 0.4 – 1.5 vol. % of a phase based on tantalum carbide. The alloy consists essentially of 10 – 13.5 wt.% chromium, 8 -10 wt.% cobalt, 1.25 – 2.5 wt.% molybdenum, 3.25 – 4.25 wt.% tungsten, 4.5 – 6 wt.% tantalum, 3.25 – 4.5 wt.% aluminum, 3 - 4.75 wt.% titanium, 0.0025 – 0.025 wt.% boron, up to about 0.05 wt.% zirconium, 0.05 – 0.15 wt.% carbon, and having no intentional addition of niobium and no intentional addition of hafnium. The balance is essentially nickel and the amount of aluminum plus the amount of titanium is between about 6.5 – 8 wt.%. The article has at least comparable hot corrosion resistance (measured at 1600°F) and at least twice the oxidation resistance (measured at 2000°F) when compared with a directionally solidified having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and a balance of nickel, and without application of a solution heat treatment.

Independent claim 12 recites a high strength corrosion resistant nickel base superalloy that is adapted for use in columnar grain directionally solidified articles. The alloy includes about 12 wt.% chromium, 9 wt.% cobalt, 1.9 wt.% molybdenum, 3.8 wt.%

tungsten, 5 wt.% tantalum, 3.6 wt.% aluminum, 4.1 wt.% titanium, 0.015 wt.% boron, 0.1 wt.% carbon, and no intentional addition (and in any event less than about 0.02 wt.%) zirconium. There is no intentional amount of niobium and the balance is essentially nickel and incidental impurities, wherein the amount of aluminum plus the amount of titanium is about 7.7 wt.%. There is additionally a matrix containing about 0.4 – 1.5 vol. percent of a phase based on tantalum carbide. The article is also characterized by oxidation resistance at 2000°F of roughly 2.5X and the creep rupture life at 1400°F of roughly 2.4X compared to a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and the balance of nickel, and without application of a solution heat treatment.

Grounds of Rejection to be Reviewed on Appeal

I. Whether claims 1-3 and 5-14 are properly rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement.

II. Whether claims 1-3 and 5-14 are properly rejected under 35 U.S.C. §103(a) as being unpatentable over WO99/67435 to Esser et al. (hereafter "Esser").

III. Whether claims 1-3 and 5-14 are properly rejected under 35 U.S.C. §103(a) as being unpatentable over EPO Document No. 0855449A1 to Mitsuhashi et al. (hereafter "Mitsuhashi").

Arguments

I. *Rejection of Claims 1-3 and 5-14 under §112, First Paragraph*

The Examiner argues that the specification of the present application allegedly fails to comply with the written description requirement because the claims contain subject matter which is not described in the specification in a way as to reasonably convey to one skilled in the art that the inventor(s) of the present application had possession of the claimed invention. However, contrary to the Examiner's assertion, the present application (see paragraphs 9, 14 and 18) supports the claimed feature of not utilizing a solution heat treatment. The application unequivocally states that one goal is

to provide an article or alloy that has adequate creep strength without the use of solution heat treating. Thus, one ordinary skill in the art would recognize from the specification that the claimed properties could be achieved without the use of solution heat treating. For this reason, the rejection is improper and must be withdrawn.

II. *Rejection of Claims 1-3 and 5-14 as Obvious over Esser*

The Examiner argues with regard to the claimed feature "without application of a solution heat treatement," that this feature is in effect a process limitation that one of ordinary skill in the art would have considered to have been obvious because this step does not lend patentability to the claimed product. However, even if the solution heat treating is considered to be a process step, the Examiner's conclusion improperly ignores the implication that the heat treatment history of the article or alloy, or lack of heat treating history, affects the microstructure of the article/alloy with regard to properties and size, shape, or presence of microstructural features. The feature "without application of a solution heat treatement" therefore cannot be ignored and must be given due weight in the examination. In this regard, the claimed alloy and article of claims 1 and 12 provides good properties, including creep properties, without subjecting the alloy or part to a solution heat treatment step. In comparison, the article of the Esser reference is subjected to a solution heat treatment at 2300°F and would result in parts having unacceptable creep and other properties.

Additionally, the Examiner contends that Esser's article prior to the heat treatment, is in the non-heated treated state and thereby meets the present claims. However, the unfinished workpiece, prior to heat treating, in the Esser reference cannot be considered to be the claimed article. In Esser, the castings are heat treated at a temperature of 2300°F (page 8, line 5). Such a heat treatment is apparently required in Esser to obtain the properties disclosed therein, such as stress rupture. Thus, one of ordinary skill in the art would not consider the unfinished workpiece to be an article that has suitable oxidation and corrosion resistance for use in a turbine engine, for example. The Esser reference requires the heat treatment to obtain the desired stress rupture and other properties and thereby teaches against not using solution heat treating because doing so would preclude obtaining the properties desired in Esser.

For the above reasons, the rejection is improper and must be withdrawn.

III. *Rejection of Claims 1-3 and 5-14 as Obvious over Mitsuhashi*

Similar to the rejection based on Esser, the Examiner argues with regard to the claimed feature "without application of a solution heat treatement," that this feature is in effect a process limitation that one of ordinary skill in the art would have considered to have been obvious because this step does not lend patentability to the claimed product. For the same reasons as above under section II of this Brief, the Examiner's conclusion improperly ignores the implication that the heat treatment history of the article or alloy, or lack of heat treating history, affects the microstructure of the article/alloy with regard to properties and size, shape, or presence of microstructural features.

The Examiner also contends that Mitsuhashi's article, prior to the heat treatment, is in the non-heated treated state and thereby meets the present claims. However, as pointed out above under section II, one of ordinary skill in the art would not consider the unfinished workpiece to be an article that has suitable oxidation and corrosion resistance for use in a turbine engine, for example.

For the same reasons as in section II, the rejection is improper and must be withdrawn.

CLOSING

For the reasons set forth above, the final rejection of claims 1-3 and 5-14 is improper and must be reversed.

Respectfully submitted,

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Date: August 24, 2010

CLAIMS APPENDIX

1. A directionally solidified article having more than one crystal comprising a high strength, corrosion and oxidation resistant nickel base superalloy which comprises a matrix and from about 0.4 to 1.5 vol. % of a phase based on tantalum carbide, the alloy consisting essentially of, in weight percent, of: 10-13.5% chromium; 8-10% cobalt; 1.25-2.5% molybdenum; 3.25-4.25% tungsten; 4.5-6% tantalum; 3.25-4.5% aluminum; 3-4.75% titanium; 0.0025-0.025% boron; up to about 0.05% zirconium; 0.05-0.15% carbon; and having no intentional addition of niobium; no intentional addition of hafnium;

and balance essentially nickel; wherein aluminum + titanium is between about 6.5-8%;

said article having at least comparable hot corrosion resistance (measured at 1600° F.) and at least twice the oxidation resistance (measured at 2000° F) when compared with a directionally solidified having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni, and without application of a solution heat treatement.

2. The article of claim 1, wherein the article comprises a columnar grain, directionally solidified article.

3. The article of claim 2, wherein the article has transverse ductility in excess of 5% at 1400° F and at 1800° F.

5. The article of claim 1 having stress rupture resistance sufficient to ensure that a load of about 27 ksi applied ruptures only after more than 45 hours, and also has a time to 1% creep of more than 15 hours, at 1800° F.

6. The article of claim 5, wherein stress rupture occurs only after more than 85 hours.

7. The article of claim 1, having 11-13% chromium; 8.25-9.75% cobalt; 1.5-2.25% molybdenum; 3.4-4.3% tungsten; 4.7-5.5% tantalum; 3.3-4% aluminum; 3.75-4.3% titanium; 0.008-0.025% boron; up to about 0.04% zirconium; 0.04-0.15 carbon; wherein aluminum + titanium is between about 7-8%.

8. The article of claim 1, having about 12% chromium; 9% cobalt; 1.9% molybdenum; 3.8% tungsten; 5% tantalum; 3.6% aluminum; 4.1% titanium; 0.015% boron; 0.025% zirconium; 0.10% carbon; up to about 0.02 Zr and having no intentional addition of niobium; no intentional addition of hafnium; balance essentially nickel.

9. The article of claim 1, wherein the article comprises a gas turbine engine component.

10. The article of claim 9, comprising a turbine blade or vane.

11. The article of claim 1, further characterized by oxidation resistance at 2000° F of roughly 2.5X, and creep rupture life at 1400° F of roughly 2.4X and at 1800° F of at least roughly 1.5X a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

12. A high strength, corrosion resistant, nickel base superalloy adapted for use in columnar grain directionally solidified articles, comprising in weight percent of about 12% chromium; 9% cobalt; 1.9% molybdenum; 3.8% tungsten; 5% tantalum; 3.6% aluminum; 4.1% titanium; 0.015% boron; 0.1% carbon; and having no intentional addition (and in any event less than about 0.02) zirconium and no intentional amount of niobium; balance essentially nickel and incidental impurities, and wherein aluminum + titanium is about 7.7 %; and including a matrix containing from about 0.4 to 1.5 vol. % of a phase based on tantalum carbide, the article is characterized by oxidation resistance at 2000° F of roughly 2.5X and creep rupture life at 1400° F of roughly 2.4X compared to a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni, and without application of a solution heat treatment.

13. The alloy of claim 9, comprising a gas turbine engine component.

14. The article of claim 13, comprising a turbine blade or vane.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

Decision on Appeal dated July 21, 2008 (copy attached).

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ALAN D. CETEL and DILIP M. SHAH

Appeal 2008-3158
Application 10/023,565
Technology Center 1700

Decided: July 21, 2008

Before BRADLEY R. GARRIS, MICHAEL P. COLAIANNI, and JEFFREY B. ROBERTSON, *Administrative Patent Judges*.

ROBERTSON, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) (2002) from the Examiner's final rejection of claims 1-3 and 5-14.[1] (Examiner's Answer

[1] Claim 4 has been cancelled. (Third Supplemental Appeal Brief filed July 24, 2007, hereinafter "App. Br.," 6).

entered, Oct. 26, 2007, hereinafter "Ans."). We have jurisdiction pursuant to 35 U.S.C. § 6(b) (2002).

We AFFIRM.

THE INVENTION

Appellants' claimed invention is a directionally solidified article comprising a corrosion and oxidation resistant superalloy including about 0.4 to 1.5 vol. % of a phase based on tantalum carbide. (Spec. [015] and [018]). The superalloy is composed of the following elements: 10 – 13.5% chromium, 8 – 10% cobalt, 1.25 – 2.5% molybdenum, 3.25 – 4.25% tungsten, 5.5 – 6% tantalum, 3.25 – 4.5 % aluminum, 3 – 4.75% titanium, 0.0025 - 0.025% boron, up to about 0.05% zirconium, 0.05 – 0.15 % carbon, with no intentional addition of niobium or hafnium, where the balance is essentially nickel, and the sum of aluminum + titanium is between about 6.5 – 8%. (Spec. [026] and Original Claim 1). Appellants claim that the article has at least comparable hot corrosion resistance (measured at 1600°F) and at least twice the oxidation resistance (measured at 2000°F) when compared with a directionally solidified alloy having a nominal composition of 14 chromium (Cr), 4.9 titanium (Ti), 1.5 molybdenum (Mo), 3.8 tungsten (W), 2.8 tantalum (Ta), 3 aluminum (Al), 9.5 cobalt (Co), 0.01 boron (B), 0.02 zirconium (Zr), 0.1 carbon (C), and balance nickel (Ni). (Spec. [026] and Original Claim 1).

Appellants also claim a high strength corrosion resistant superalloy adapted for use in columnar grain directionally solidified articles having 12 % chromium, 9 % cobalt, 1.9 % molybdenum, 3.8 % tungsten, 5 %

tantalum, 3.6 % aluminum, 4.1 % titanium, 0.015 % boron, 0.1 % carbon, no intentional addition of zirconium (less than about 0.02%), no intentional amount of niobium, where the balance is essentially nickel and incidental impurities, and where aluminum + titanium is about 7.7 %. (Spec. [026] and Original Claim 12). The article is characterized by oxidation resistance at 2000°F of roughly 2.5X and creep rupture life at 1400°F of roughly 2.4X when compared to a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni. (Spec. [017] and [026]).

Claims 1 and 12, reproduced below, are representative of the subject matter on appeal.

> 1. A directionally solidified article having more than one crystal comprising a high strength, corrosion and oxidation resistant nickel base superalloy which comprises a matrix and from about 0.4 to 1.5 vol. % of a phase based on tantalum carbide, the alloy consisting essentially of, in weight percent, of: 10 – 13.5% chromium; 8 – 10% cobalt; 1.25 – 2.5% molybdenum; 3.25 – 4.25% tungsten; 5.5 – 6% tantalum; 3.25 – 4.5 % aluminum; 3 – 4.75% titanium; 0.0025 – 0.025% boron; up to about 0.05% zirconium; 0.05 – 0.15 % carbon; and having no intentional addition of niobium; no intentional addition of hafnium; and
>
> balance essentially nickel; wherein aluminum + titanium is between about 6.5 – 8 %;
>
> said article having at least comparable hot corrosion resistance (measured at 1600°F) and at least twice the oxidation resistance (measured at 2000°F) when compared with a directionally solidified having a nominal composition of 14 Cr,

4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

12. A high strength, corrosion resistant, nickel base superalloy adapted for use in columnar grain directionally solidified articles, comprising in weight percent of about 12 % chromium; 9 % cobalt; 1.9 % molybdenum; 3.8 % tungsten; 5 % tantalum; 3.6 % aluminum; 4.1 % titanium; 0.015 % boron; 0.1 % carbon; and having no intentional addition (and in any event less than about 0.02%) zirconium and no intentional amount of niobium; balance essentially nickel and incidental impurities, and wherein aluminum + titanium is about 7.7 %; and including a matrix containing from about 0.4 to 1.5 vol. % of a phase based on tantalum carbide, the article is characterized by oxidation resistance at 2000°F of roughly 2.5X and creep rupture life at 1400°F of roughly 2.4X compared to a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

THE REJECTIONS

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Mitsuhashi	EP 0 855 449 A1	Jan. 23, 1998
Esser	WO 99/67435	Dec. 29, 1999

The following rejections are before us on appeal: (1) claims 1-3 and 5-14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over

Esser; and (2) claims 1-3 and 5-14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mitsuhashi (Ans. 3-9).[2]

Regarding the rejection of claims 1-3 and 5-14 under 35 U.S.C. § 103(a) as being unpatentable over Esser, the Examiner found that Esser teaches directionally solidified nickel based superalloys having compositions that overlap the alloys recited in Appellants' claims. (Ans. 3-5). The Examiner stated that the differences between Esser and the present claims are: (1) Esser does not teach the exact same alloy proportions; (2) Esser does not disclose the use of Zr; and (3) Esser is silent with respect to the claimed corrosion and oxidation resistance. (Ans. 5). The Examiner determined that the claimed alloys would have been obvious in view of Esser because: (1) the proportions of Zr recited by the claims include 0%; (2) the proportions of elements in Esser's alloys overlap the claimed proportions; and (3) since Esser's alloys have compositions that overlap the claimed alloys and have the same amount of tantalum carbide phase, Esser's alloys would be expected to possess all the same properties recited in the claims. (Ans. 5 and 6).

[2] Appellant appeals the provisional obviousness-type double patenting rejection of claims 1-3 and 5-14 over US 2004/0200549 (copending U.S. Application No. 10/315,704). A search of the PTO's Patent Application Locating and Monitoring (PALM) system indicates that the application 10/315,704 was abandoned on June 15, 2006 (Notice of Abandonment mailed June 15, 2006). Accordingly, because application 10/315,704 has been abandoned, the Examiner's provisional obviousness-type double patenting rejection is moot. *See*, MPEP § 804(I)(c) (Rev. 6, Aug. 2006). We give no further discussion of the moot provisional rejection in this Decision.

Regarding the rejection of claims 1-3 and 5-14 under 35 U.S.C. § 103(a) as being unpatentable over Mitsuhashi, the Examiner found that Mitsuhashi teaches nickel base columnar grain directionally solidified superalloy having a composition that overlaps the alloy recited in Appellants' claims. (Ans. 6-8). The Examiner found that the differences between the present claims and Mitsuhashi were that: (1) Mitsuhashi does not teach the exact same alloy proportions; (2) Mitsuhashi does not disclose the use of zirconium; and (3) Mitsuhashi is silent with respect to the properties recited in the claims and the presence of tantalum carbides. The Examiner determined that the claimed alloys would have been obvious to one of ordinary skill in the art because: (1) Appellants' claims do not require the presence of zirconium; (2) the proportions of Mitsuhashi's alloy overlap with the proportions of the alloy recited in the claims; and (3) since Mitsuhashi's alloys have compositions that overlap the claimed alloys, Mitsuhashi's alloys would be expected to have the same properties as recited in the claims. (Ans. 8 and 9).

Regarding Esser, Appellants contend that the zirconium content in Esser's alloys does not overlap with the present claims. (App. Br. 4). Appellants argue that there is no mention of zirconium content or carbon content in one embodiment of Esser, and no mention of any zirconium in a particularly preferred embodiment of Esser. (App. Br. 3 and 4). Appellants argue that Esser teaches away from the present invention because Esser suggests that lower B levels would result in a useless alloy. (App. Br. 4). Appellants also argue that Esser does not teach or suggest the corrosion or

oxidation resistance properties of the alloy, and that the improvement in these properties of the alloy is unexpected given the similarity between the compositional values in the claims and the compositional values in Esser. (App. Br. 4).

Regarding Mitsuhashi, Appellants contend that the alloys disclosed therein contain small amounts of other elements that are not present in the claimed alloys. (App. Br. 5). Appellants also contend that while Mitsuhashi teaches that the absence of zirconium is beneficial in conjunction with the heat treatments applied, these heat treatments are not required in the present invention. (App. Br. 5). Appellants further argue that Mitsuhashi suggests that lower boron levels do not produce alloys that are useful for directionally solidified parts. (App. Br. 5). Appellants argue that while Mitsuhashi requires the zirconium content to be below 5 ppm, the alloys of the present claims "exhibit significantly higher Zr contents." (App. Br. 5). Appellants further argue that Mitsuhashi does not teach or suggest the corrosion or oxidation resistance properties of the alloy, and that the improvement in these properties of the alloy is unexpected given the similarity between the compositional values in the claims and the compositional values in Mitsuhashi. (App. Br. 5).

ISSUE

The following issue is before us on this appeal: Have Appellants shown that the Examiner erred in rejecting the appealed claims as being obvious to one of ordinary skill in the art over the cited prior art of record?

We answer the question in the negative.

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

1. Appellants' Specification states:

> The generally preferred composition of the present invention consists essentially of, in weight percent, about 10 - 14.5% chromium; 8 - 10% cobalt; 1.25 - 2.5% molybdenum; 3.25 - 4.25% tungsten; 4.5 - 6% tantalum; 3.25 - 4.5% aluminum; 3 - 5% titanium; 0.0025 - 0.025% boron; up to about 0.02% zirconium; 0.05 - 0.15% carbon; and having no intentional addition of niobium; no intentional addition of hafnium; and balance essentially nickel; wherein aluminum + titanium is between about 6.5 - 8%. The alloy also includes roughly about 0.4 to 1.5 vol. % of a phase based on tantalum carbide. More preferably, the alloy comprises about 11- 13% chromium; 8.25 - 9.75% cobalt; 1.5 - 2.25% molybdenum; 3.4 - 4.3% tungsten; 4.7 - 5.5% tantalum; 3.3 - 4% aluminum; 3.75 - 4.3% titanium; 0.008 - 0.025% boron; up to about 0.02% zirconium; 0.08 - 0.13 carbon; wherein aluminum + titanium is between about 7 - 8%. Most preferably, the alloy comprises about 12% chromium; 9% cobalt; 1.9% molybdenum; 3.8% tungsten; 5% tantalum; 3.6% aluminum; 4.1% titanium; 0.015% boron; less than 0.02% zirconium; 0.10% carbon; and having no intentional addition of zirconium (any in any event less than about 0.02 Zr) and no intentional addition of niobium; no intentional addition of hafnium; balance essentially nickel. (Spec. [026]).

2. Appellants' Specification states:

> We discovered that even small additions of zirconium detrimentally affected the castability of part, particularly large

parts such as land based gas turbine engine blades. Articles having more than about 0.02 wt. % zirconium tended to tear after on investment casting, during cooling and solidification of the molten material. While not fully understood, the tearing problem was obviated where zirconium was present in less than about 0.02 wt. percent. Accordingly, the inventive composition includes no intentional additions of zirconium, and whether or not it is practical to tolerate about up to about 0.02 wt. %, we prefer less. (Spec. [027]).

3. Appellants' Specification states:

Alloy	Cr	Ti	Mo	W	Ta	Al	Co	B	Zr	C	Hf
GTD 111	14	4.9	1.5	3.8	2.8	3	9.5	0.01	0.02	0.1	0
4,597,809	12.2	4.2	1.9	3.8	5	3.6	9	0	0	0.07	0
Mod1	11.56	4.03	1.84	3.75	5.1	3.55	8.9	0.005	0.014	0.07	0.49
Mod2	11.68	4.04	1.83	3.72	4.96	3.58	8.86	0.005	0.015	0.06	0.88
Mod3	12.25	4.01	1.83	3.69	5.01	3.5	8.82	0.018	0.091	0.11	0.48
Mod4	11.94	4.03	1.84	3.75	5.15	3.55	8.93	0.008	0.02	0.06	0.01
Mod5	11.61	4.05	1.84	3.74	5.29	3.57	8.89	0.008	0.032	0.07	0.49
Mod6	11.9	4	1.82	3.7	4.93	3.52	8.79	0.019	0.103	0.12	0.94

The articles to be evaluated were investment cast, and then given similar heat treatments - a solution heat treat at about 2050° F for 2 hours, followed by precipitation heat treat at 1975 F for 4 hours, followed by stabilization heat treat at about 1550° F for 24 hours. In some cases, articles were solution heat treated at 2150 - 2200° F for less time, but showed no significant increase in properties. (Spec [028]).

4. Appellants' Specification does not indicate that heat treatments applied at temperatures above 2200°F would be detrimental to the claimed articles.

5. Claim 1 sets forth a range that includes more than 0.005 % by weight (0.0025 to-0.025%) and the amount of boron in claim 12 (0.015%) is greater than 0.005% by weight.

6. Table I in Esser is reproduced below:

TABLE I

Heat	Cr	Co	Mo	W	Ta	Al	Ti	C	B	Ni
#1	12.1	9.0	1.8	3.7	5.2	3.6	4.0	0.7	0.001	balance
#1A	12.1	9.0	1.8	3.7	5.2	3.6	4.0	0.8	0.010	balance
#2	12.1	9.0	1.8	3.7	5.2	3.6	4.0	0.9	0.011	balance

Table I shows the compositional make up of a comparison alloy (#1) as well as two alloys according to Esser's invention (#1A and 2).

7. The boron content in Esser's comparative example #1 is 0.001% and the boron content in the examples according to Esser's invention, #1A and #2, are 0.01% and 0.011%, respectively. (Table I).

8. Esser states:

> The present invention modifies the aforementioned nickel base superalloy to include boron in the alloy in an amount discovered effective to provide substantial transverse stress rupture strength and ductility of a DS columnar grain casting produced from the alloy as compared to a similar casting without boron present. Preferably, the nickel base superalloy is

modified by the inclusion of boron in the range of about 0.003% to about 0.015%, preferably 0.010% to 0.015%, by weight of the superalloy composition to this end. In conjunction with addition of boron to the superalloy composition, the carbon concentration is controlled in a preferred range of about 0.05% to about 0.11% by weight of the superalloy composition. (p. 5).

9. Esser states:

The DS columnar grain castings were cooled to room temperature under vacuum in the chamber, removed from the mold in conventional manner using a mechanical knock-out procedure, heat treated at 1250 degrees C (2282 degrees F) for 4 hours, analyzed for chemistry, and machined to specimen configuration. (p. 8).

10. Table 1 of Mitsuhashi is reproduced below:

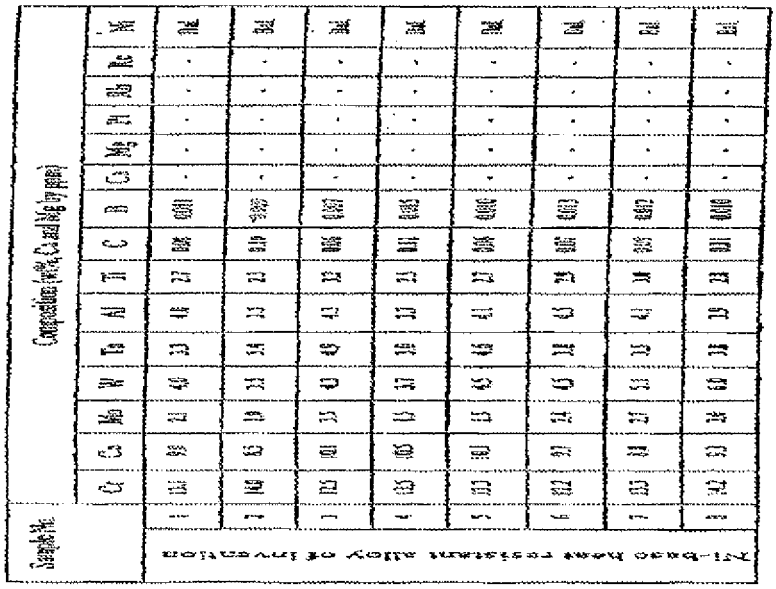

Table 1 shows the compositional make up of 8 alloys according to Mitsuhashi's invention. (p. 12).

11. Mitsuhashi states:

> The large-size cast article of columnar Ni-base heat-resistant alloy, having high resistance to intergranular corrosion at high temperature, can be produced by a process which comprises the steps of: preparing a large-size casting or a large-size turbine blade casting of a a [sic] columnar Ni-base heat-resistant alloy by using a uni-directional solidifying apparatus, by pulling a chill plate at a speed of 200 to 350 mm/h while the mold temperature is held within a range of from 1480 to 1530°C, conducting an HIP by holding the casting for 1 to 5 hours at a temperature of 1180 to 1265°C [2156 to 2309 °F] under a pressure of from 900 to 1600 atm., conducting a solid-solution heat treatment by holding the casting for 2 to 5 hours at a temperature of from 1200 to 1265°C [2172 to 2309 °F] and subjecting the casting to a two-staged aging heat treatment having a first stage of holding the casting for 2 to 10 hours at a temperature of from 950 to 1080°C and a second stage of holding the casting for 16 to 24 hours at a temperature of from 760 to 870°C. (p. 8, ll. 35-44).

12. Mitsuhashi states:

> The present inventors also have made a study to improve resistance to intergranular corrosion of large-size cast turbine blades at high temperature, and discovered that the a [sic] columnar Ni-base heat-resistant alloy casting exhibits improved resistance to intergranular corrosion at high temperature, when the columnar Ni-base heat-resistant alloy casting is produced by a process which comprises the steps of: preparing a melt of an Ni-base heat-resistant alloy having a composition in which the Zr content is limited to trace amounts and which contains, by weight, Cr: from 12.0 to 14.3 %, Co: from 8.5 to 11.0%, Mo: from 1.0 to 3.5%, W: from 3.5 to 6.2%, Ta: from 3.0 to 5.5%, Al: from 3.5 to 4.5 %, Ti: from 2.0 to 3.2 %, C: from 0.04 to 0.12 %, B: from 0.005 to 0.05 %, Zr: from 0.001 to 5 ppm, and

> the balance substantially Ni and incidental impurities.... (p. 3, l. 56 through p. 4, l. 5.)

PRINCIPLES OF LAW

"Section 103 forbids issuance of a patent when the 'differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.' " *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007).

The prior art must be considered as a whole, including non-preferred embodiments disclosed therein. *See Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, (Fed. Cir.), cert. denied, 493 U.S. 975 (1989). In addition, "[t]he prior art's mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed...." *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

A showing of unexpected results may be sufficient to overcome a *prima facie* case of obviousness. *In re Dillon*, 919 F.2d 688, 692-93 (Fed. Cir. 1990). Such a showing must be based on evidence, not argument or speculation. *In re Mayne*, 104 F.3d 1339, 1343-44 (Fed. Cir. 1997), *In re Schulze*, 346 F.2d 600, 602 (CCPA 1965). Further, the evidence must be reasonably commensurate in scope with the claimed invention. *In re Greenfield*, 571 F.2d 1185, 1189 (CCPA 1978).

ANALYSIS

Appellants have not argued the claims separately. Accordingly, we largely confine our discussion to appealed claim 1, which contains the claim limitations representative of the arguments made by Appellants and address claim 12 where appropriate pursuant to 37 C.F.R. § 41.37(c)(1)(vii) (2006).[3]

The rejection of claims 1-3 and 5-14 under 35 U.S.C. § 103(a) as being unpatentable over Esser

We are not persuaded by Appellants' arguments that attempt to distinguish Esser from the claimed invention based on the zirconium and carbon content of the claimed alloys. Specifically, Appellants have not rebutted the Examiner's finding that the amounts of zirconium claimed include alloys containing no zirconium. Appellants have presented no evidence that the limitations "up to about 0.05% zirconium" and "having no intentional addition (and in any event less than about 0.02%) zirconium" in claims 1 and 12 respectively, exclude the alloys disclosed in Esser. Appellants' argument that in Esser, "there is no mention of any Zr content, although the absence of another embodiment that does include any Zr (and

[3] Only those arguments actually made by Appellants have been considered in this decision. Arguments which Appellant could have made but chose not to make have not been considered and are deemed to be waived. *See* 37 C.F.R. § 41.37 (c)(1) (vii) (2004).

the 'consisting' language) suggests that there is no Zr in this 'most preferred' alloy," appears to support the Examiner's finding that Esser's alloys contain no zirconium. (App. Br. 4, Ans. 12-13).

Regarding the carbon content of Esser's alloys, Appellants acknowledge that Esser teaches embodiments of alloys containing carbon. (App. Br. 3). This is consistent with the Examiner's position that Esser teaches a preferred embodiment having a carbon content of 0.05 to 0.11%. (Ans. 13, FF 8). Therefore, Appellants' arguments are not sufficient to rebut the Examiner's determination of obviousness as the carbon content disclosed in Esser overlaps Appellants' claimed range of 0.05-0.15% carbon.

Appellants' argument that Esser teaches away from the present invention because Esser suggests that lower boron levels result in a useless alloy does not distinguish Esser from the present claims. Appellants state that the "lower B levels" in Esser are amounts less than 0.01 wt. %. (App. Br. 4). However, the workable range disclosed in Esser (0.003%-0.015%) (FF 8) is fully encompassed by the range set forth in claim 1 (0.0025-0.025%). Moreover, the boron content in Esser's examples is within Appellants' claimed range at 0.01% and 0.011%. (FF 6). Therefore, contrary to Appellants' argument that Esser teaches away from the present claims, Esser teaches values that are encompassed by Appellants' claimed range. *See In re Fulton*, 391 F.3d at 1201.

In addition, we agree with the Examiner that Appellants have not produced any evidence that the oxidation or corrosion resistance values as claimed would have been unexpected. Appellants have not rebutted the

Examiner's finding that the overlap in percentages as well as the exact same amount of tantalum carbide present in each alloy means that both alloys would be expected to possesses all the same properties. (Ans. 14). *See In re Best*, 562 F.2d 1252, 1255 (CCPA 1977). Further, in order to prove unexpected results, the invention must be compared with the closest prior art. *In re Payne*, 606 F.2d 303, 316 (CCPA 1979). In the instant case, the comparative alloys recited in the claims do not represent the closest prior art. Rather, the alloys in Esser, which do not contain any zirconium, represent the closest prior art. In addition, the examples in Appellants' Specification set forth only one embodiment (Mod4) falling within the ranges claimed in claim 1, and no embodiments falling within the claimed ranges of claim 12. (FF 3). Compare, for example, the boron content in claim 12. Claim 12 recites 0.015% boron, while Mod4 contains 0.008% boron, which is about one-half the claimed content. (FF 3). Thus, the alleged unexpected results are also not commensurate in scope with the claimed alloys. *See Id.*

Appellants additionally argue that according to Esser, the carbon content of the alloy gives rise to the desirable results of the alloy, rather than the boron or zirconium content and Esser's heat treatment would destroy parts produced from the alloy of the present invention. (App. Br. 3 and 4). These arguments do not distinguish the present claims from Esser. Whether the carbon, boron, or zirconium content of the alloy is responsible for the desirable results of the alloy is not relevant, because the Examiner found that the amounts of these components disclosed in Esser overlap or are encompassed by the amounts disclosed in the claims. In addition, the

temperature of the heat treatment applied in Esser does not distinguish the claims, which are directed to articles and superalloys and not to methods of making the articles or superalloys. (Ans. 13).

Further, Appellants' arguments are inconsistent with both Esser and the Specification. We agree with the Examiner that Appellants have not explained how Tables I and II in Esser support their determination that the carbon content gives rise to the desirable results of the alloy. (Ans. 12). Table I in Esser shows little variation in the carbon content between the comparative example (#1, carbon content: 0.7%) and the examples according to Esser's invention (#1A and #2, carbon content: 0.8% and 0.9%, respectively). (FF 6). In contrast, the boron content in the comparative example (#1, boron content: 0.001%) and the examples according to Esser's invention (#1A and #2, boron content: 0.01% and 0.011%, respectively) is dramatically different. (FF 6, 7). These results clearly show that Appellants' determination is inconsistent with Esser's disclosure, which focuses on the amount of boron and not the amount of carbon added to the alloy. (FF 8).

In addition, Appellants have provided no evidence to support their statement that the parts of the present invention would be destroyed at the temperatures applied in Esser. Appellants' Specification discloses heat treatments at temperatures of up to 2200°F compared to 2282°F in Esser. (FF 3 and 9). Appellants' Specification does not indicate that heat treatments applied at temperatures above 2200°F would be detrimental to the claimed articles. (FF 4).

Appellants further contend that at least with respect to B and Zr content, the Examiner's citation of *In re Peterson*, 315 F.3d 1325 (Fed. Cir. 2003) is inapposite. Appellants have not explained this position. As in the present case, the amounts of the superalloy claimed in *Peterson* overlapped or were encompassed in the prior art. 315 F.3d at 1329. The court in *Peterson* found that the claims had not been compared to the closest prior art, that there was no showing of criticality of the amounts of rhenium commensurate in scope with the claims, and the prior art did not teach away from the invention. 315 F.3d at 1331-1332. As discussed above, the B and Zr content of Esser overlaps with or are encompassed by the presently claimed values. Therefore, Appellants' arguments are not persuasive.

The rejection of claims 1-3 and 5-14 under 35 U.S.C. § 103(a) as being unpatentable over Mitsuhashi

Regarding Appellants' argument that the alloys of Mitsuhashi include amounts of other elements that are not presently claimed, we agree with the Examiner that Mitsuhashi's alloys do not require the presence of these additional elements. (Ans. 15). Indeed, Mitsuhashi discloses several embodiments that do not contain any of the additional elements mentioned by Appellants. (FF 10). In addition, regarding Appellants' argument that the additional elements in Mitsuhashi are not claimed, claim 1 employs the transitional phrase "consisting essentially of" and claim 12 employs the transitional phrase "comprising" with respect to the alloy. Regarding claim 1, the transitional phrase "'consisting essentially of' limits the scope of a

claim to the specified ingredients and those that do not *materially* affect the *basic* and *novel* characteristic(s) of a composition." *In re Herz*, 537 F.2d 549, 551-52 (CCPA 1976) (emphasis in original). If applicants contend that additional steps or materials in the prior art are excluded by the recitation of "consisting essentially of," applicants have the burden of showing that the introduction of additional steps or components would materially change the characteristics of applicant's invention. *In re De Lajarte*, 337 F.2d 870, 873-74 (CCPA 1964). In the instant case, the Specification is silent regarding the additional elements that may be present in Mitsuhashi's alloys and Appellants have not shown that the presence of the additional elements would materially affect the basic and novel characteristics of the invention. Regarding claim 12, we agree with the Examiner that the open transitional phrase "comprising" does not preclude the additional elements of the alloy from the claim. (Ans. 15 and 16). Therefore, Appellants' arguments are not persuasive.

Appellants' contention that the zirconium content in the present alloys is significantly higher than the zirconium content of Mitsuhashi's alloys is not persuasive. (App. Br. 5). As discussed above, Appellants' claimed alloys do not require zirconium. In fact Appellants appear to prefer amounts of zirconium that amount to no intentional addition or less than 0.02% by weight. (FF 1 and 2). This is consistent with the teaching in Mitsuhashi that the amount of zirconium is limited to trace amounts, or in amounts of from 0.001 to 5 ppm. (FF 12). Therefore, we agree with the Examiner that the

zirconium content of Mitsuhashi's alloys overlap with the present claims. (Ans. 17).

We also agree with the Examiner that Appellants have provided no evidence to support their position that Mitsuhashi suggests that lower levels of boron are unsuitable for directionally solidified parts. (Ans. 16). Nor have Appellants explained how this would distinguish the present claims as the amounts of boron disclosed in Mitsuhashi are consistent with the amounts of boron set forth in the present claims. That is, claim 1 recites a range of 0.0025 to 0.025% boron and claim 12 recites in 0.015% boron, which overlap or are included in the 0.005% to 0.05 % by weight range disclosed in Mitsuhashi. (FF 5).

We are not persuaded by Appellants' arguments regarding the heat treatments applied in Mitsuhashi. We agree with the Examiner that the specific heat treatments employed in Mitsuhashi are not relevant to the present claims. (Ans. 16). As discussed above with respect to Esser, the present claims are not process claims and incorporate no process limitations. Additionally, the heat treatment temperatures applied in the present invention (up to 2200°F) overlap with the heat treatment temperatures disclosed in Mitsuhashi (2156°F - 2309°F and 2192°F - 2309°F). (FF 3 and 11). Appellants do not suggest any detrimental affects on parts produced at temperatures above those discussed in the Specification.

Regarding the claimed oxidation and corrosion resistance and Appellants' comments with respect to *In re Peterson*, Appellants' arguments are not persuasive for the same reasons as discussed above with respect to Esser.

CONCLUSION

In light of the above discussion, Appellants failed to demonstrate that the Examiner erred in rejecting claims 1-3 and 5-14 under 35 U.S.C. § 103(a) as being unpatentable over Mitsuhashi or Esser.

ORDER

The Examiner's decision rejecting claims 1-3 and 5-14 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR §1.136(a)(1)(iv).

AFFIRMED

tc

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